Rapid false lumen dilation and pseudocoarctation due to inadvertent preferential false lumen perfusion using the frozen elephant trunk technique in a chronic residual aortic dissection

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ABSTRACT

A patient with a chronic postdissection distal arch aneurysm was treated with total arch replacement and frozen elephant trunk. Following uneventful initial recovery, the frozen elephant trunk appeared to be inadvertently perfusing the false lumen through an already present (in retrospect) intimal tear, resulting in rapid dilation of the false lumen and proximal compression of the graft. Treatment consisted, first, of endovascular redirection of flow toward the distal true lumen and, second, open surgical repair of the remaining type IV aneurysm. This case underlines the importance of scrutinizing preoperative imaging for correct use of the frozen elephant trunk. (J Vasc Surg Cases and Innovative Techniques 2020;6:101-3.)

Keywords: Aortic dissection; Frozen elephant trunk; Aortic arch; TEVAR

CASE REPORT

A 56-year-old patient developed a postdissection aneurysm in the distal aortic arch and descending aorta with a diameter of 59 mm 15 years after a type A aortic dissection for which a valve-sparing David procedure with ascending aorta replacement was performed. The patient is known to have Loeys-Dietz syndrome. His other comorbidities, linked with this syndrome, are pectus excavatum and history of embolism of the retinal artery with residual hemianopia.

Open surgical repair of the pathologic process was planned by a midsternal redo procedure, resecting the total aortic arch and leaving a Thoraflex hybrid plexus graft (26 × 28 × 150 mm; Vascutek, Inchinnan, Scotland) as a frozen elephant trunk technique to exclude the false lumen antegradely. A staged open surgical repair of the remaining aneurysm was considered to be indicated only in case of persistent false lumen perfusion from distal re-entry. The operation was performed without any technical difficulties under hypothermic circulatory arrest using bilateral antegrade selective cerebral perfusion. The patient was able to be extubated soon after the procedure without hemodynamic or neurologic problems. Postoperatively, however, we noted acute renal failure, which slowly recovered partially in the next days, as well as therapy-resistant hypertension. Blood pressure was markedly higher in the arms compared with the legs.

On postoperative day 8, we routinely performed a contrast-enhanced computed tomography scan before scheduled discharge, which showed the following surprising features. First, a massively enlarged false lumen at the distal arch, measuring 91 mm (preopervely, 59 mm), was seen. Second, the stent graft had penetrated the septum and preferentially perfused the false lumen. Furthermore, the proximal part of the frozen elephant trunk was severely compressed, conceivably causing the clinically noted pseudocoarctation (Fig 1).

We hypothesized that the proximal stent graft was extrinsically compressed because of the severely pressurized false lumen (dynamic stenosis), but we could not exclude the possibility of an inadvertent twist at the distal suture line (static stenosis). It at least explained the observed blood pressure difference as well as the observed persistent renal failure postoperatively.

To prevent early rupture, we decided to urgently extend the frozen elephant trunk with an additional thoracic stent graft (Gore cTAG 34 × 200 mm; W. L. Gore & Associates, Flagstaff, Ariz), redirecting flow toward the true lumen and hence depressurizing the false lumen. As such, the remaining thoracoabdominal aneurysm was reduced from a Crawford type II to a type IV.

The dynamic nature of the frozen elephant trunk stenosis could be demonstrated by balloon inflation before the stent graft procedure, which showed undisturbed inflation yet rapid recoil (Fig 2). After stent graft implantation, ankle-arm pressure indices equalized immediately, and at 1 week, renal failure had completely resolved. Control computed tomography scanning showed adequate position of the stent graft with preferential flow into the true lumen now. Nevertheless, a distal re-entry at renal level persistently perfused the now massively dilated false lumen retrogradely. Given the acutely enlarged false lumen (91 mm) in this young Loeys-Dietz patient, we decided finally

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Fig 1. First postoperative computed tomography image showing the distal part of the stent graft penetrating the septum. Furthermore, a large aneurysm with false lumen flow can be seen compressing the stent graft proximally.

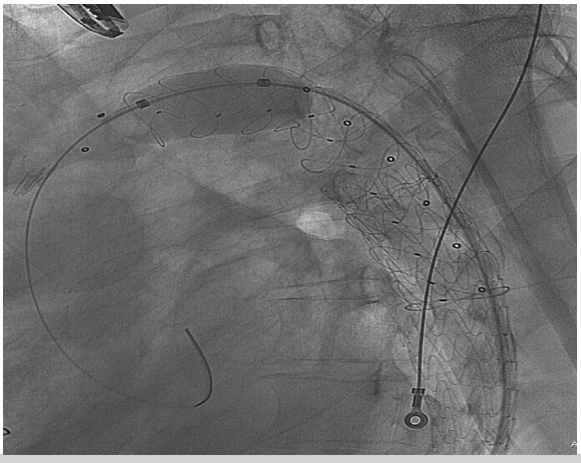

Fig 2. Periprocedural balloon dilation of the extrinsically compressed proximal part of the frozen elephant trunk.

to perform open surgical repair of the remaining type IV aneurysm (Fig 3). The procedure was uncomplicated, with uneventful recovery of the patient.

The patient consented to publication of this case report and images.

DISCUSSION

Stent graft-induced new entry (SINE) is a well-known complication of thoracic stent grafting, especially in acute or chronic dissections, as has been described recently.[1] Risk factors are oversizing, connective tissue disorders, and the intrinsic "spring-back" mechanism of the stents. The frozen elephant trunk is also self-expanding but with a shorter stent (length of 10 or 15 cm in the case of the Thoraflex hybrid), with a potentially larger spring-back force on the distal end, as suggested by Li et al.[2]

Fig 3. Three-dimensional reconstructed computed tomography angiography image 6 months postoperatively. Note the re-expanded proximal part of the stent graft and the open reconstruction up to the infrarenal aorta (where the dissection flap becomes visible again).

The routinely applied technique of antegrade and direct introduction of the Thoraflex hybrid graft in the true lumen without visual feedback of the distal landing zone may potentially increase this risk. A suggested option could be to add angioscopy for visual feedback after stent graft implantation during systemic arrest.[3] Other options are direct feedback of the perfusion pressures and transesophageal echography confirmation of blood flow. Using fluoroscopy with contrast enhancement after circulatory arrest is perceived to be nephrotoxic and is not routinely performed in our center for that reason.

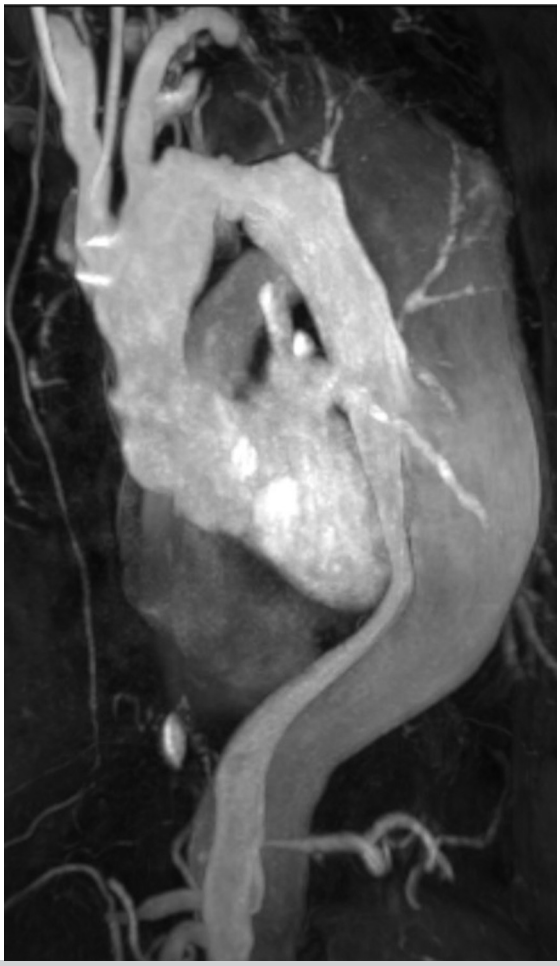

Fig 4. Preoperative magnetic resonance angiography image (three-dimensional reconstruction) showing the postdissection type II thoracoabdominal aneurysm after prior ascending aorta surgery. Note the hazy aspect of the septum at the midthoracic level, suggesting a re-entry tear.

Kreibich et al[4] reported an 11% incidence of distal SINE after frozen elephant trunk implantation, most in chronic dissections. In these cases, they tended to use the smallest possible frozen elephant trunk prosthesis as a preventive measure. In a series of 21 patients with distal SINE after frozen elephant trunk reported by Wang et al,[5] all patients fortunately could be successfully treated endovascularly. In our case, the intimal opening caused flow to go preferentially toward the false lumen, resulting in massive growth of the descending aorta aneurysm together with pseudocoarctation.

As we retrospectively scrutinize the preoperative magnetic resonance angiography image (Fig 4), we do see a hazy aspect of the septum at the location of the proximal descending aorta, exactly at the location where the frozen elephant trunk ended and had resulted in a distal SINE-like appearance. However, a pre-existent re-entry tear could have been present here. Preventive measures are prosthesis related but mainly imaging related. The frozen elephant trunk prosthesis should be selected carefully with attention to diameter (avoiding oversizing, especially in acute or chronic dissections) but also to length (avoiding inadvertent ending at the level of a disrupted intimal membrane, leading to this distal SINE-like event). By scrutinizing preoperative imaging, identifying possible weaknesses in the septum or possible re-entries, the appropriate length should be determined. In this case, a shorter frozen elephant trunk could have been chosen with immediate (short) thoracic endovascular aortic repair (TEVAR) extension during the rewarming phase, bearing in mind that this carries an increased paraplegia risk.

This report shows that distal SINE is an inherent risk of the frozen elephant trunk technique and is not limited to standard TEVAR. A recent case report shows a similar case of inadvertent frozen elephant trunk deployment into the false lumen even with occlusion of the false lumen and fatal intestinal ischemia.[6]

CONCLUSIONS

Postoperative imaging after a frozen elephant trunk procedure before discharge and during follow-up may be essential to identify these potential complications early. Treatment consists of urgently redirecting flow into the true lumen and excluding the false lumen. When an erroneous placement is suspected during the primary procedure, an extension TEVAR may even be introduced during the rewarming phase.

In this case, a two-stage approach was performed: first, urgent endovascular repair to redirect flow and to treat the pseudocoarctation (reducing the remaining aneurysm from a type II to a type IV); and second, a staged open surgical repair of the remaining distal part.

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